DOCUMENT RESUME

ED 183 210 IR 008 160

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TITLE Review of Selected Telemedia Delivery Systems. Telecommunications Study Commission, Working Paper No. 13.
INSTITUTION Virginia State Telecommunications Study Commission, Richmond.
PUB DATE 23 Aug 79
NOTE 73p.: For related documents, see IR 008 152-153 and IR 008 158

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Cable Television: Delivery Systems: *Fixed Service Television: Intercommunication: *Networks; *State Programs: *Telecommunication
IDENTIFIERS *Subsidiary Communication Authorization; *Virginia

ABSTRACT

This paper discusses three aspects of telecommunication programming delivery--instructional television fixed services, subsidiary communication authority, and cable television--and applies these systems to Virginia's requirements, pointing out their future potential in the Commonwealth. The potential of network interconnection is also discussed and related to current aspects of simultaneous message delivery throughout Virginia. (Author/RAO)

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Working Paper # 13

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TELECOMMUNICATIONS STUDY COMMISSION

"REVIEW OF SELECTED TELEMEDIA DELIVERY SYSTEMS"

AUGUST 23, 1979

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INTRODUCTION

Some management policy and decision making is dependent upon features of telemedia technology as much as it is on organizational and management factors. In this paper, attention is paid to three little used aspects of telecommunication programming delivery and to the idea of networking--the interconnection of telemedia stations electronically to allow for simultaneous direct broadcast of program materials.

While some brief attention was given to Instructional Television Fixed Service (ITFS), Subsidiary Communications Authorization (SCA) and Cable Television in Working Paper #5, "Telemedia Technology," this paper attempts to apply these systems to the Virginia situation and to point up some conclusions relevant to their future potential in the Commonwealth. The potential of network interconnection is also discussed and related to current aspects of distribution of a state message or messages simultaneously throughout the Commonwealth.

SUBSIDIARY COMMUNICATIONS AUTHORIZATION

Major Edwin H. Armstrong, the inventor of frequency modulation (FM on your radio dial) reported of his discovery in the proceeding of the Institute of Radio Engineers in his 1936 paper titled "A Method of Reducing Disturbances in Radio Signaling by a System of Frequency Modulation". Part of this paper was an explanation of multiplex operation. Multiplexing is the simultaneous transmission, or sending of two or more messages over the same transmission roadway. This is the essential characteristic of Subsidiary Communications Authorization or SCA radio use.

In today's technology, it is possible to send from a FM broadcast transmitter/antenna:

a. the main, say, stereo-music channel with its pilot tone,

b. voice quality channel for point-to-point communications and,

c. a data channel

The b and c receiving points are controlled by special receivers and are not available to general audiences.

Commercial stations have a history of utilizing the SCA for "musicasting," "storecasting," or "transitcasting" to public transportation vehicles. Their subscription services generally supply background music for doctor's offices, stores, factories, etc.; services for which the station charges the user.

The noncommercial stations, which can also be defined as university, school, or public radio stations are not in a position to make profit from this type of service. The FCC limits the noncommercial use of SCA transmissions within its rules.

FCC Rules Abstract (73.594, 593, 395)

The important fact in this rule is that the SCA license cannot exist without an FM license; it is a subpart of the FM license and it is nontransferable. The FCC must be notified of changes to the operational or equipment procedures by the operator, and in some cases, special permission sought. For example: special permission must be obtained to read commercial materials such as newspaper ads to the visually handicapped.

Program material on noncommercial SCA must be educational in purpose, noncommercial in nature, and benefit or appeal to a limited audience.

When an SCA operation is leased by a third party, the leasing arrangements must be in writing and on file for FCC inspection. A most important aspect which many leasees tend to ignore is that the operator licensee (the station) is responsible for content with right to reject. In the financial area, the FCC tends to be very definite that charges for production, airing, and line distribution are allowed. Commercial content, announcements and profit are not allowed. Educational institutions may charge for tuition and any other charges that would accompany course material if it were presented by another means.

Special "Q-tones" may be aired to start or stop specialized recorders designed to receive individualized messages, but this should be done only with FCC permission.

Services mentioned as permissible by the FCC are discussed later in this paper.

Possible Uses of SCA

The following is a summary or listing of possible uses for subsidiary communications authorizations (SCA), commercial or non-commercial (FCC 73.293):

1. relay service - for networking
   a. news - specialized
   b. music radio service
2. transmitter control/metering
3. religious programming
4. instructional programming
   a. higher education with limited enrollment
   b. can be privacy protected
5. background music (most commercial operators)
6. foreign language programs
7. sporting events
8. cultural education
9. stock, commodity, business reports
10. security information
11. wholesale grocery information
12. news and weather
13. medical bulletins
14. medical education (privacy protected)
15. show-scan television for medical and other uses
16. reading service to the blind (a leading use among non-commercial FM operators)
17. data information to computers
18. facsimile - alpha-numeric or braille, and in the near future,
19. teletext as soon as some form of standardization in the U.S. will be achieved. The French Antiope System is highly adaptable to television, SCA and telephone. The English

CEEFAX and Oracle systems are television transmission systems and are being used by the British TV networks (educational and industrial TV).

20. any other audio or data - many other types of communications, voice and data, can be transmitted via the SCA (subcarrier) technology to a selected audience via the distribution of specialized receivers. Privacy can be protected. A good example is the Ohio Medical Education Network (OMEN) covering the state with SCA transmissions from 14 local FM stations. Another example of agricultural SCA usage in the midwest is the transmission of grain and stock market quotations to subscribing farm organizations, in this case, by a series of commercial stations.

National Use of SCA

On the national level approximately 20% - 25% of the FM stations have the FCC authorizations to utilize the subcarrier. The FCC central card and file system makes it impossible to extract the types of usage and the percentage of each type. The important significance of the fact that 80% of the FM stations have not applied for SCA authorization is that there exists a large unused resource with varied possibilities.

In the past, most commercial stations provided "storecasting" type background music to subscribers. Among the noncommercial broadcasters today, much of SCA radio is being used to provide "talking books" for the blind. In Minnesota, a state network finds that SCA is the only feasible way to achieve this service:

1. It is the only cost-effective system for providing full-time service (in Minnesota, 19 1/2 hours a day). To us, full-time service is important, since we want to include a broad cross section of the materials being read by the public. We want to meet the needs of people with a wide variety of interests. We want to provide materials usable by people with various levels of comprehension, and we want time to provide programming for those with shorter attention spans, such as some of our institutionalized and older listeners.

2. The SCA is regarded by the FCC as a private means of communication. We have a stable, gradually increasing audience that has come to understand why we include books that many people like, but that others find offensive.

3. The third virtue of the SCA system is that it permits us to ready copyrighted materials without requesting permission, which must be the case if the material is to be fresh. We are careful about eligibility: only those who cannot effectively read printed materials, because of visual or physical handicaps, are listeners. They are people who would not buy a publisher's book or magazine, because in its printed form they cannot use it.

There are now approximately 50 Radio Reading Services using the SCA medium in the U.S. and Canada, plus about 25 planning sites. The Association of Radio Reading Services was formed at a national conference in 1977. (ETDS-102)

Other services suggested by many on a national level like training for nurses, police, firemen, and special information including data for business, for educators, etc., can be provided bv SCA radio.

New applications for SCA services with the FCC seems to indicate a growing trend to the diversification of services via SCA.

The noncommercial broadcaster is limited on SCA just as he is limited on the main channel to noncommercial material which must be educational in purpose and is designed for a limited audience (FCC - 73.593).

The following are examples of services that a noncommercial station may offer to governmental, educational, and other non-profit agencies:

a. classroom instruction - all grade levels

b. professional education

c. trade groups - engineers, etc. - education

d. ethnic programming

e. social groups programming

f. handicapped programming

g. governmental information

h. individualized instruction

Charges may be made by the noncommercial ITFS broadcasters for:

a. airing the program

b. producing the program . . . for the originating agency.

Charges may be made to the students by the educational institution for tuition and any other charges (texts, lab fees, etc.) that would accompany the course material if it were presented by another means.

Cost of SCA

The cost of SCA transmission and distribution is minimal, whether a commercial or noncommercial station is engaged to provide the service.

The installation cost per SCA channel is about $5,000 per station, and the cost per special receiver is $35 - $75. The lease of time on a per station basis is a possibility and in case of educational institutions, the lease of the special receiver can be included in the tuition or lab fee.

An example of starting a series of university radio credit courses, if the university happens to be a licensee of an FM station, would be the installation cost of the SCA generator and monitoring equipment and the anticipated course enrollment for in-home instruction.

Cost of SCA generator and monitor equipment.	$5,000
Cost of Studio (leased from university station)	
Voice receiver cost of 4 classes with enrollment limitation of 50	$7,000
	$ 12,000

The initial investment of $12,000 covers hardware costs to start SCA instruction. The cost of faculty, instructional materials, and administration, lease of individual receivers could be included in the tuition and fees charged the student. Costs could elevate if studios need to be constructed or equipment for delayed broadcast is needed. Start up costs could range from the $12,000 listed above to $75,000 for a luxurious SCA operational origination point. If teletype transmission is advocated, the cost per receiving point is $600 to $800. Or if braille printer receiving points are installed, the cost per receiving point is $800 to $2500.

Leasing of SCA time on an existing station can vary from station-to-station depending upon the value attached by management to their SCA operation and the public service attitude of the station. Commercial stations have allowed educational and noncommercial organizations to use the SCA "without cost". The educational organizations do vary for the installation of the needed equipment and the legal fees in the licensing process with FCC.

A possible cost of leasing SCA time with an existing FM station could be $25,000 annually for a 40-hour week or 8 hours per day broadcast time at an hourly cost of $1.50.

The above amount is minimal compared to open channel television

ITV programming, which in Virginia averages about $85.00 per hour.

SCA - National Level

The NAB (National Association of Broadcasters) has neither encouraged or discouraged the use of SCA, but since the "Reading to Visually Handicapped" services have come into being on a national scale utilizing both commercial and noncommercial outlets, the NAB has formed a use committee, the "All Industry Committee on Future Use of TV-Broadcast Anscillary Signals" (William Putman, Chmn.). The purpose of the committee is to study the potential of SCA and all other anscillary signals. The major considerations nationally may be:

a. better technical quality for SCA is in the coming.

b. less "free" use of SCA by non-profit organizations as the commercial operators discover considerable profit in their SCA operations.

c. the development of quadrophonic broadcasting may make SCA type private communications not feasible for stations transmitting in quadrophonic mode.

d. standardization of "teletext" similar to the French system may make SCA a valuable visual transmission tool where privacy must be protected.

e. slow-scan television (another SCA technology capable of transmitting audio/video information to a television set reminding one of a slide presentation) has been used by education and industry, but has not developed rapidly. It probably is being supplanted by the teletext technologies.

f. SCA services of a popular nature - reading services, stock market reports, etc., can be distributed nationally via satellite by commercial or noncommercial means.

SCA Status in Virginia

SCA transmissions are not planned by many Virginia noncommercial stations due to the fact that many are unaware of the SCA technology, others are skeptical about the expense effectiveness due to

their range limitations (they cover very small geographic areas), and a few are concerned with signal degradation on the main channel.

The two organizations which are encouraging and working toward a SCA network for Virginia are The Virginia Voice for the print Handicapped, Inc., who provide reading services to the print handicapped via subcarrier broadcasts, and the Center for Excellence which plans on an experimental basis to provide a much broader service in the Williamsburg area including:

1. SCA audio reading services for the visually impaired
2. SCA teletype, or TTY, for the hearing impaired
3. SCA Braille teleprinter for the deaf-blind

CenTeX has been transmitting primarily through the FM subcarrier of WBCI, but plans to extend via cable and ITFS distribution are in the future.

Virginia Voice was established as a non-profit organization in 1978 with grants from the American Foundation for the Blind and the Virginia Commission for the Visually Handicapped. It has its own board of directors with representatives from telecommunications, education, and the Commission for the Visually Handicapped. The governing board has charged Virginia Voice to:

a. plan and establish a state network
b. plan and establish a fund raising method to become financially self-sufficient.

The staff has moved in these directions and has identified many stations to achieve statewide coverage of reading services to 15,000 Virginians who are reading impaired. The goal is to

provide 30 hours/weekly/4 to 7 p.m. of network service statewide. Programming would include national magazines, daily state newspapers, current "best sellers," and discussion programs of topical interest to the visually handicapped. The programs originate in the Richmond studios and broadcast live each weekday 7 to 11 a.m. Stations participating and/or considering participating are:

WBCI-FM	Williamsburg (CenTeX) -	75 persons served
WVWR	Roanoke	300 persons served

Possible expansions forthcoming in the following areas:

WRFK, Richmond

WMRA, Harrisonburg

WHRO-FM, Norfolk

WYCS, Yorktown

The above listing of stations does not cover the state, and two of the stations are not full power FM stations. It would take seven or more full power (50 KW) stations to cover the state, and at present there exist only four (CPB qualified) public radio stations in the State appropriation for this use. Since the Commonwealth is not fully covered by signals from full power (NPR) stations, it is impossible to achieve full subcarrier coverage of the State. Subcarrier coverage of the geographic area of the State by utilizing low power FM stations would be cost prohibitive since the cost of SCA hardware and installation is identical for a low power and a high power station.

Costs in Virginia

The Virginia Voice for the Print Handicapped proposed operating budget for FY 1979-80 is $44,278 (see appendix for itemized budget). CenTeX's past budget for reading/printing service operations for FY 1978-79 is $62,000.

Individual station's estimated cost, if they undertake SCA reading operations on their own, would be

$7,000 for a very basic installation

$15,000 salary/supplies for SCA coordinator (annually),

and a considerable additional amount of volunteer help for readers. Funding for or volunteers could be available from Title XX, local clubs, local businesses, Commission for the Visually Handicapped, American Federation of the Blind, and individual users of the system.

Management Issues - Considerations

The issues in Virginia are very much the same as those on the national level, except as these would apply to a smaller model.

The development of an SCA network is underway by the Virginia Voice. That staff could probably absorb management of a network also so that duplicate management structures are probably not necessary.

In its beginning stages, the Virginia Voice network is functioning very well. If additional services were being sought by individual state agencies and another SCA network should be created, it would be at that time the management structures to meet the needs of the "new" network should be considered. The need for statewide SCA network has not been established, but on the other hand, many agencies and institutions throughout Virginia are not aware of SCA and its potentials. It is impossible to need something of which you are not aware.

Conclusions

In comparing Virginia SCA operations to other states, national trends, and existing plus future potentials, it can be stated that Virginia is lagging in the utilization of a "coming" medium of telemedia distribution. The following are the outstanding conclusions.

A. The geographic area of the Commonwealth is not covered via a strong noncommercial (NPR) radio signal, and therefore, cannot be effectively covered with SCA signals for its specialized programming listed in this paper or as required by the State Master Plan.

B. Limited SCA usage in the Commonwealth has been restricted to two programming concepts. The development of both is encouraged by many state communicators.

   1. Programming to the Visually/Reading Handicapped, voice and/or facsimile modes. Funding from various sources has gone into this effort, and many participants feel more support is needed in this area.

   2. Instructional radio is a viable force which has been neglected within the Commonwealth. Station managers, program directors, and other practitioners on a state and national level recommend that instructional radio be delegated to SCA transmission mode. This, they claim, is due to the small audience potential of specific courses as contrasted to the broader appeal of NPR programming. Reasoning behind this is "it is a waste to have a 3rd grade math program for 200 students on the main spectrum when they could be reaching thousands". Nationally, there is an increasing use of subchannels for educational purposes.

C. There is a lack of experimentation using SCA (or open channel) for education/instruction via radio in Virginia. There is also a lack of state support for this experimentation, either financial or highly visible indications of interest.

D. Technology trends indicate that in the distant future (five years and beyond) it is apparent that other uses mentioned earlier should be explored as technology in those areas reaches teen-hood and/or maturity.

   Areas that would probably benefit governmental activities directly are:

      a. teletext - visual information distribution to regional centers or offices

b. professional education - state employees, medical, and others

c. data transmission to regional data banks or office computers.

E. Continuous examination of varied technologies applicable to SCA (i.e., data) distribution system and funding for same is lacking in Virginia - state expended for innovative experimentation/demonstration with SCA and backed by federal grant monies coming into the state could yield a high rate of return due to enlarged GSP (gross state product) and broadened tax revenue.

The "coming" technology is being examined seriously on a national level. Virginia has not provided much input or involvement with SCA, except with Virginia Voice and CenTeX experimentations.

INSTRUCTIONAL TELEVISION FIXED SERVICE

Among the varied ways of delivering television signals to schools is I.T.F.S. (Instructional Television Fixed Service). The others are cable, open air television, community antenna (CATV) systems, microwave links, and even satellites. This paper intends to focus upon the uses of I.T.F.S., its strengths and its weaknesses, and hopefully to its cost-effectiveness picture as it may apply to the Commonwealth. It is not the interest of this paper to summarize the strengths of television per se, but concentrate upon the uniqueness of I.T.F.S.

ITFS - Its Beginnings

On July 25, 1963 the Federal Communications Commission (FCC) opened 31 channels in the 2500-2690 megahertz (mega cycle) frequency range for the use by educational institutions and organizations. It was the intent of the F.C.C. to supplement - not replace - the standard educational TV broadcast service. To date this grouping has been adjusted to 28 channels in seven groups of four channels each. The groups are labeled A through G in the F.C.C. Rules and Regulations and are delegated strictly to the educational process.

This grouping of channels into clusters of four is one of the major strengths of the ITFS system. It allows the delivery of several programs to each school at any given time. Such delivery is or can be cost-effective with any other system,

including newer cable systems.

ITFS systems have grown from six in 1965 to 198 today, transmitting on 517 separate channels. (Appendix A) Today, through several rule changes ITFS can also transmit two-way voice or data communication between the studio and the educational audience so that interactive education can take place.

Strength/Advantages Of ITFS Systems

ITFS systems offer several major advantages as a delivery system in education. Among them are:

1. Four channel capacity for scheduling programs for varied courses in the school system, or have several channels available for demand services.
2. Two-way capability: video/audio transmitted to students - voice or data return on subcarrier from students (telephone voice return is also feasible).
3. Privacy is protected since it can not be received on home television sets. Audience can be controlled when needed.
4. Costs less to construct and operate, if applied to small audiences[1] in flat geographic areas.
5. Can be networked via translator system: translator receives signal from the main transmitter or translator and feeds it to another transmitter at the same location. This transmitter then rebroadcasts the signal to schools beyond the range of the main trans-

[1]Compared to PTV distribution (single channel)

mitter. The system can be replicated to form a regional or statewide network. (See also "networking".)

Weakness Of The ITFS System

Some shortcomings are also inherent in the ITFS system:

1. Range is limited to 20 -25 miles in average terrain with much shorter range in mountainous areas. (Power is limited to ten Watts.)
2. Picture quality is not equal to the image quality radiated by powerful commercial or PTV stations.
3. ITFS is limited to selected receiving points (schools, institutional buildings) through the use of a special antenna system and down-converters. The cost and installation averages $1,500.00 per receiver site.
4. It can not reach a broad audience, when/if program content requires it.
5. Not very cost-effective in mountainous areas due to line-of-sight signal generated by ITFS transmitter. Range becomes limited and systems need to be repeated to cover a large geographic area.
6. Not cost-effective in high-saturation cable areas. Here cable can do the same things as ITFS and often better.

Summary of Present F.C.C. Rules (F.C.C. Vol 3. 74.901 - 74.984)

ITFS is assigned in the 2500 MHZ - 2686 MHZ area of the spectrum with each channel in groups of four leaving a six megahertz channel width. This makes possible seven groupings of four

channels. Each licensee is limited to four channels in a single area of operation. All of which must be of the same group. If an applicant needs one or two channels at the start of his program, he may request the reservation of the remainder of the channels within his group but this is not guaranteed by the Federal Communications Commission.

The primary purpose of ITFS, is for the delivery of instructional materials, primarily, to students enrolled in accredited public and private schools, colleges and universities. The F.C.C. lists secondary purposes as in-service training of teachers, safety programs, professional and technical training for the licensee or other agencies approved by the licensee. Examples include: medical personnel, fire personnel, state employees, etc.

During non-instructional periods the ITFS system may be used for administrative activities of the licensee such as: (1) tele-conferences, (2) distribution of reports, (3) exchange of data and statistics and (4) other similar uses. Great care must be taken, so that administrative traffic does not overshadow the instructional purpose of ITFS. The F.C.C. makes it plain that "stations will not be licensed solely for transmission of administrative traffic." (74.931) Licenses may be issued to institutional or government organizations engaged in formal education of enrolled students or a non-profit organization providing instructional material to the above organizations. For example, a non-commercial television licensee providing instructional material to schools is eligible for ITFS license. The accredita-

tion by/of State Department of Education is helpful in obtaining an ITFS license.

Many F.C.C. rules deal with operation requirements, logging, power requirements of response stations, and other technical data. One rule is important to this analysis:

> "Stations may be licensed as relays to interconnect ITFS systems, commercial or non-commercial information CCTV systems and terminals. Material so delivered by ITFS channel may be for simul-viewing or may be recorded for use at later time"
> (F.C.C. 74.931)

An example of possibilities of the above rule is an integrated ITFS-CATV system, in Toledo, Ohio, designed to deliver local government information to citizens on the cable and to public locations for citizens not on the cable. Television coverage of council meetings, meeting schedules, agendas, and other public information will be broadcast (KCET Report).

Uses of ITFS on National Level

Nationally the dimensions of the telecommunications "world" are increasingly expanded by technology. Microwave distribution services of Instructional Television Fixed Service (ITFS), Multipoint Distribution Service (MDS), (considered by many the commercial "common carrier" cousin of ITFS) and other special services authorized by the F.C.C. are further expanding the potential for delivery of audio, video, and data information services to homes, schools and institutions (Carnegie Report).

ITFS has centered heavily in many realms of education:

1. Public schools
2. Private schools (limited almost exclusively to Catholic archdiocesan operated in large cities.

3. Graduate schools:

TAGER - in Dallas, Texas
Stanford in Palo Alto, California
IHETS (Indiana Higher Education TV System)
All three serve about 23,000 students (ASEE-37)

4. Medical schools:

Such as Georgia Regional Medical Television Network. The Network delivers programming to 31 medical institutions located within 25 miles from the Emory Medical School (ASEE-38)

5. Rural education

In Chautauqua County, N.Y. & in Fresno, California provide structural curricula to schools with limited staffs.

The above examples indicate the variety of uses of ITFS that have developed. Most of the time it is being used as a one (or multi-channel) ITV delivery system in the way "open air" single channel systems have been used in the past. In a few instances the two-way capacity of ITFS has been documented and the two-way capacity has also been tried on cable, but the educational value in learning gains has not been fully proven.

The approach taken by many stations nationally has been directed toward a mix of media rather than the dependence on one. For example:

Stations in San Diego, Spokane, Toledo, Cleveland, and many other places supplement broadcast offerings with Instructional Television Fixed Service or cable television distribution.

A different public telecommunications model is the West Central Illinois Educational Telecommunications Corporation, also known as Convocom, headquartered in Springfield and not yet operational. Convocom, a consortium of community-licensed public television stations and educational institutions, is arranging a multifaceted production and distribution system employing television, radio, Instructional Television Fixed Service, common carrier microwave, cable television, and videocassette. Scheduled to begin operating in late 1979, Convocom is funded by diverse private and public sources. (A Public Trust)

With multiple services provided by NPR, PBS, and the growth of regional consortia, ITFS usage will involve many other media and it is doubtful if it will stand alone as the mainstay of ITV, as some have thought in the past.

Cost

The cost of building a single channel ITFS station is considerably less than a single channel PTV station. The capital expenditure for an average four channel system could be $285,000, while a full power PBS station could easily cost 2.5 to 3 million dollars.

The annual operating costs can vary anywhere form $44,258 to a high of $738,100, depending on various factors:

1. the number of channels
2. the number of school sites in system
3. number of pupils served
4. geography of the distribution area
5. amount of self-generated materials used by system

In terms of dollars ITFS has been very cost-effective in local or regional situations of fairly high population density, with rather flat terrain and a few shadow areas where multiple systems can easily be linked to the ITFS signal. The cost of replicating the coverage area of a PTV station would equate to the cost of six or seven ITFS systems: depending on terrain, and therefore, the savings of an ITFS system may be negated. The annual system cost of an ITFS system covering a state such as Virginia can be estimated - $17,134,680.00 The above annual cost covers 10 years of equipment depreciation and

including operational and programming costs for all channels.[2]

National Considerations for ITFS

Nationally only half of the states are utilizing ITFS in one way or another and many ITFS systems are coordinating with other technologies such as cable, satellite, and as extensions of the PTV stations.

On the national level the ITFS operators have not been the "voice" of ITV operations. There are presently several considerations or issues executives should consider as they think about ITFS:

1. Will ITFS be supplanted by extensive cable systems, since anticipated cable growth is 11% saturation per year (according to the U.S. Chamber of Commerce). (Cable systems can have the same operational characteristics as ITFS.)

2. Will the FCC cut channels or channel groups for other uses if ITFS is insufficiently used? There is a petition before the FCC to acquire ITFS channels for MDS (Multipoint Distribution System) usage by MDS interests. The commission (FCC) has not yet acted on the petition.

3. In spite of cable's equality for signal delivery in the near future in many geographic areas, ITFS has continued to grow. There was a dramatic increase from 1975 to 1977 - a total of 22 systems licensed. There has been a leveling of growth between 1977 - 1979 to only 12 systems and this leveling of ITFS development seems to correspond with cable deregulation by the FCC and the anticipated growth of cable systems.

ITFS - in Virginia

The only ITFS installation in Virginia is located in Williamsburg and is operated by the Center for Excellence (CenTeX). CenTeX is a nonprofit educational research and

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[2]AN ED 138242

resource development corporation. Its objectives can be summarized as follows:

1. to identify and define the major unfilled educational needs of the geographic areas which it seeks to serve;

2. to develop the educational curricula, teaching capabilities and resources to meet these unfilled needs; and

3. to make intensive use of modern electronic technologies, such as telecommunications, to increase the teaching effectiveness and the distribution scope of educational services.

4. to establish in the Tidewater area of Virginia America's first educational/medical/social services telecommunications system "laboratory."

To achieve these goals, CenTeX is using ITFS standard lines, CATV and FM multiplex in its operations and the following projects have utilized the technology in a two-way mode. (The establishment of the ITFS system is documented in "A Report Regarding the Establishment of an Instructional Television Fixed Service System in the Williamsburg/Hampton Area," House Document #10, 1976.)

A. Project SETT-UP

Special Education via Telecommunications/Teacher Upgrade

B. Project HITT

Homebound Interactive Training via Telecommunications

C. Project SCS

Special Communications Services - for detailed description of project, see Appendix D.

D. Project TIMES

Telecommunications in Medical and Educational Services and Project GETT-UP - Gifted Education via Telecommunications: Teacher Upgrade, both are, at the time of this writing, in the developmental and funding stages. All projects for CenTeX have been federally funded except Project SETT-UP which was partially

funded through the Virginia Department of Education. The amount of the contract was $125,000.00 The remainder was HEW funds - $670,000.00 through the "Bureau of Education for the Handicapped."

The project is a continuing project and the Virginia Department of Education has committed $13,000 in FY 79/80 towards the completion of the project at a state level. It is not the purpose of this study to evaluate CenTeX and its activities, but only to illustrate its involvement and commitment to ITFS technology.

Conclusions

1. The ITFS technology has been given a secondary status within the media delivery systems in the Commonwealth. This may be due to the attitude of many PTV managers that ITFS is an obsolete system which may not survive the onslaught of cable, video discs, video cassette recorders, etc. The public stations in Virginia are finding more cost effective methods to contract with cable companies for more than one channel to distribute their software to the users. A Rand study seems to indicate cable as a more cost effective way, especially if your target audience is or can be located within school buildings or other public buildings.

2. The ITFS technology has also been given a secondary status within the Master Plan for Public Telecommunications (Part 1, page 45). The mention of ITFS technologies are in parenthesis and are in reference to another technology.

3. From a technical standpoint, ITFS is limited in geographic coverage by ten watt output which translates into

20 miles maximum along an average terrain.

4. Due to item (3), it is, therefore, an excellent "local" distribution medium with limited receiving installations and for small audiences.

5. It is cost prohibitive in mountainous areas as a regional network distribution technology, except on a small scale into non-cable areas.

6. On the national level the ITFS technologies are being developed and incorporated as part of larger communications systems utilizing a mix of technologies (Example: Convocom in Illinois).

7. The two-way capability and privacy aspects of ITFS cited by CenTeX are also possibilities in cable or SCA operations at much less cost than ITFS (Rand Studies).

8. The feeling among communicators in the state is that experimentation should continue, but cable technology is or will be available to large segments of population and will be near most schools in the future.

BROADCAST INTERCONNECTION

1) Introduction
2) Virginia Telemedia Networks
3) Possible Advantages of Statewide Networks for Virginia
4) Possible Costs
5) Conclusions.
6) Appendix
    a. Map of Virginia Microwave Links
    b. Listing of Virginia Public Radio-TV Stations
    c. TV Networks
    d. Radio Networks
    e. State Network Plan
    f. Bibliography

INTRODUCTION

Networking in broadcasting consists of interconnecting two or more stations or locations for simultaneous transmission of program materials, or the interconnection of specific locations (e.g., libraries, stations, schools) for simultaneous distribution of materials that can be recorded for later use.

The idea dates to January 4, 1923, when telephone circuits connected radio stations WNAC in Boston and WEAF in New York for a five minute saxophone solo originating at WEAF. (Head - 76) About two years later, AT&T lines linked twenty-two stations coast to coast as President Coolidge spoke to the U.S. Chamber of Commerce in Washington, D.C. Today, the national networks link 200-300 stations each either via telephone lines, microwave, or satellite.

The network organizations of varied structures <u>are not</u> controlled by the FCC (Federal Communications Commission) but the affiliates of the networks are, which in turn may or may not affect the network. Use of this technology is controlled by the FCC, even though the national trend seems toward deregulation, but this seems to be more in the programming area.

Any technology for simultaneous linking of many locations, which are the subject of this paper, require FCC approval. Microwave, satellite, landlines, ITFS (Instructional Television Fixed Service), MDS (Multipoint Distribution System) and to a

minor degree even deregulated cable are examples.

The national trend is toward satellite interconnection, due to rising costs of landline interconnection and the television clarity of satellite interconnection. Satellite relays overcome the problems of long distance communication because they can use efficient line-of-sight radio transmission without resorting to skywaves or scatter phenomena. (Head) Radio waves travel best in the vacuum of space. The Telstar satellite with only 25 Watts of power and an orbit of 22,300 miles, was capable of line-of-sight transmission to blanket a third of the Earth's surface.

Today, satellites of higher orbit and power (20,000) transmitters make direct-to-home transmission a reality. Comsat is considering a satellite direct-to-home pay television system by 1983, and Neiman-Marcus will be marketing a satellite ground station for consumers at $11,000 in 1979. Japanese manufacturers offer satellite down links in the area of $300 - with a one meter dish.

The satellite interconnection does not have to be permanent, but can be on a per-use schedule. Satellite usage is increasing rapidly due to falling costs of earth stations, and therefore, cost-effectiveness for distribution over large areas.

States and regional public networks can have access to one of the four transponders on Westar, leased by the Public Broadcast System. This access is not free, but is determined by the time of needed access (e.g. prime time or middle of night), availability and amount of usage. In case of schedule conflicts, priority will be given "real-time" (live) broadcast programs.

The technology is here and changing and many national networks are considering or are moving to satellite distribution. The examples are Mutual Radio Network, AP-VPI radio, PBS, and NPR by the middle of 1980. In addition, the satellite usage is available to non-broadcast public service agencies through the Public Service Satellite Consortium on a fee basis.

There is a movement of many entities toward some kind of network: telemedia, data, facsimile, etc. and toward satellite distribution. However, it must be noted that the available frequency spectrum is limited and the parking spaces for satellites are not infinite. The "space shuttle" program will facilitate lower costs, higher power satellites, and better space management, but it will not be the solution to the frequency problem.

While satellite distribution may appear cost effective and maintenance problems may be solved by the space shuttle program, there are other ways of networking telemedia products. Shared networks are being explored as is "bundling" of data landlines during off-hours to transmit broad band telemedia materials. With growth of cable at an estimated 11% annually, linking cable head-ends with microwave, and MDS (Multi-point Distribution) systems is a possibility. As an example, Big Boy Restaurants have done this in Ohio with their inventory data. (L. Patrick-79)

There exists the availability of regional networks some are satellite linked (SECA) and others via landline or microwave (EEN). The sharing of these networks or making use of their programming and schedules is always a possibility. SECA is being utilized within the state at present time.

The national EBS (Emergency Broadcast System) Network of commercial and non-commercial stations is in existence and can

be used by the states for emergency communications.

The development of inexpensive video cassette recorders, video disc, and digital video record devices makes simultaneous video or audio communications necessary only during important events or emergencies.

Virginia Telemedia Networks

Virginia has an extensive telephone and data network and a State Police microwave network, both are the subjects of other papers. This section will concentrate upon the national non-commercial networks and the few state telemedia networks in existence. The definition of a network will be the interconnection of two or more transmitting units via a selected device or series of devices.

1. PBS:

The Public Broadcast Service is the national non-commercial television network furnishing programming via a satellite distribution system. The PBS has the availability of four transponders on Master I satellite. The PBS is undergoing considerable change in programming approach and satellite usage. The suggested services at the time of this writing are:

> The multiple program services concept proposes the development of three . . . services--the "Blue," "Red" and "Green" Services for purposes of reference,
>
> The Blue Service would provide concentrated attention to a limited schedule of high quality, highly visible programming for general audiences. It would be highly promoted, seeking the largest possible audience consistent with the public service objective of the programming itself.
>
> The Red Service would be a comprehensive service designed to provide programming for general and specialized audiences, encouraging innovation and access for . . . public television and independent producers.

> The Green Service would provide a full range of educational programming for use in the home and school, including in-school instructional, adult education and children's programming . . . The Green Service would be dedicated to providing educational programming for specific target audiences as well as general children's programming.
>
> (NAEB Newsletter)

The Blue Service, and the Green Service are expected to be in operation and available for use by Virginia's public television stations and school systems during the fall of 1979.

2. NPR:

The National Public Radio provides national radio programming and is distributing its programming via AT&T long lines, but is in the process of moving to satellite distribution by April, 1980.

Both PBS and NPR find networking via satellite more economical than landlines due to the size/location of audience and most important the area to be covered. Technical quality is also better via satellite.

3. SECA:

The Southern Education Communications Association operating from Columbia, South Carolina, is a regional network providing instructional and cultural programming in television. Virginia member stations are WBRA-TV, WHRO-TV, WVPT-TV.

There is no statewide television network in Virginia on a permanent basis. Temporary networks can and have been used by Virginia's non-commercial stations, for special events. For example, Governor's Day Festivities (1978) were televised statewide from Richmond via one of the PBS-leased transponders of Westar I. The television signal from Righmond to Bren Mar,

Virginia (just south of Washington, D.C.) was sent via temporary landlines. The cost: $5,000 for the networking aspect of coverage.

The more permanent television networks in Virginia are the microwave links between given stations:

a. WCVE in Richmond and WNVT in Annandale. The link is a single microwave link reaching the limitations of microwave range. Central Virginia ETV Corporation has plans to replace the present system with a "two-hop" system as a solution to current technical difficulties. Both stations have independent staffs and programming.

b. The interconnect between WBRA in Roanoke, Virginia and its sister transmitter WSVN-TV in Norton, Virginia. Blue Ridge ETV Corporation is planning to construct a third transmetter near Marion in Smythe County. If such plans materialize, WBRA in Roanoke will be the key station for a three station network with all three stations offering almost identical programming.

The present WBRA to WSVN-TV interconnect is a "two-hop" microwave system with both stations broadcasting identical material.

c. The WBRA to the VPI-SU production facility microwave link is dormant. VPI and WBRA have found it more economical to "bicycle" the one program a week through the mail than utilize the microwave system. There are no future plans for the system. The VPI-SU to Blacksburg Cable link is fully operational but can be considered a local studio-to-transmitter link.

In radio networking the Virginia Voice Network, designed to serve the reading handicapped via "open air" or SCA transmission, is developing from Richmond to other areas of the State. The network is charged with providing current events and current materials to the Commonwealth's reading handicapped. (See SCA paper)

The State's only non-commercial radio network, Virginia Voice, is delivering its programming via electronically enhanced shared voice telephone lines. The network can operate 5 p.m. to 6 a.m. The only completed link is to WVWR in Roanoke with immediate future links to WRFK, Richmond and WYCS, Yorktown.

The network will continue to expand as stations can be committed to broadcast the programming of Virginia Voice. The network also has a "bicycling" system for stations not interconnected via telephone lines. The network "airs" via interconnect or mail on three stations throughout Virginia. The stations are located in Williamsburg, Yorktown, and Roanoke. Virginia Voice at maturity expects to delivery thirty hours of programming per week on a five-day per week basis.

The State Master Plan for Telecommunications requires that an adequate signal from public radio and television stations be available to all citizens of Virginia. It is obvious that these goals have not been met. This is especially true in the case of radio and SCA signals.

Future plans for networking public and/or instructional television signals among the state's public television stations are varied. The station managers and operators are not in full agreement upon the type of network, if one would be desirable, and

exactly how many hours per day each station could broadcast from a state network. This is especially true with the "start-up" of the PBS's three service concept. The network concepts mentioned by stations throughout the State are the following:

a. a two-way microwave network between the existing stations based upon the Pennsylvania model. The stations would be able to transmit to the network as well as receive. The network would act as a switching point for the stations and originate filmed/taped programs. It would not have a production facility. This concept was supported by the consultants.

b. extend present microwave systems for one-way distribution to stations.

c. mobile satellite up-link operated by stations and leasing transponder time as needed from PBS. The link would be the ease of originating programs from almost anywhere in the State.

The systems for delivering ITV and PTV materials to the schools and citizens of Virginia can be numerous; the technology is constantly changing and the options of networking can be multiplied if consideration is given to using the most cost effective option in each area of the State. For example, ITFS may work well in one region and microwave in another.

The options are dependent upon user needs, as well as, terrain population density, availability of technical resources in place, and ones to be installed. Considerations of maintenance operating costs and personnel are also not to be neglected. The possibilities of creating a technological mix of a network are numerous as are its uses for education, cultural enrichment, professional training, governmental communications in non-emergency

or emergency situations, and many others.

In 1976, an interconnection plan ("New Interconnection Telecommunications Needs in Virginia" was developed by the Virginia Public Telecommunications Council (VPTC). The plan outlined a start-up interconnection system. The suggested satellite system on a lease basis is a sound one, since receiving points may be added or changed without increasing the cost of transmission. The report also suggested a structural or organizational outlook through a clearing and implementing center named AVNO (Added Value Network Organization). The central clearing house concept is also sound. It is questionable., however, if the needs study done in 1976 is still valid. Therefore, the receive only and transceiver points may also not be applicable.

At the present time, VPTC feels that networking is a low priority item due to short staffing and funding levels. Increased funding levels could bring services to state agencies, institutions, schools and others through the "off-time" sharing of communications channels on a national and state level. This is due to the fact that instructional, cultural, and entertainment media in the State generally operate between 6 a.m. - 12 p.m. (on the average) and that not all of those hours are programmed by the national network. National figures show that in 1977 only 7% of a network's total offerings were broadcast in "real" time. Most of the time, the stations were feeding their transmitter from film or video tape and in case of radio, disc or tape.

The sharing of an existing network (when that network is not utilized) has tremendous potential for the State in the area of intergovernmental agency communications with telemedia.

Possible Advantages of Statewide Networks for Virginia

This section is restricted to radio, radio sub-carrier (SCA), television and television ancilliary signals. The advantages of having a state network are numerous. Following are brief listings of some of the advantages of State networks for the several kinds of telemedia systems discussed:

Radio - Open Channel (assuming full state coverage)

1. Public radio education to all citizens.
2. Emergency reports by Governor or other State agencies.
3. Alternative entertainment to what is offered by commercial broadcasting.
4. Credit-college courses of interest to the general public:
   a. consumer education
   b. sociology
   c. literature
   d. music
5. In-depth news generated by state or departments of mass communications of universities.
6. Live coverage of arts, music, etc. throughout the state.
7. Live coverage of General Assembly or court system during important discussion or trials.
8. Savings in hardware and software not being located in numerous places.

Radio - SCA Network

1. Reading current materials to reading handicapped.
2. Instructional programming to a small audience and where privacy is required.

3. Data information for various uses - (TTY), facsimile, teletext, and others.
4. Professional education statewide to state employees, medical and others.

Television - "Open Air"

1. Public television programs of high quality (like PBS), but mainly from independent distributors and producers.
2. Public affairs - news programs produced by local stations.
3. Sports programs in the state of statewide interest.
4. Historical programs for general education.
5. College courses for general public (credit or no-credit).
6. Live coverage of arts, music, drama throughout the state.
7. Production channels for the five stations - minimizing travel within the state by station personnel, therefore, a fuel savings.

The above options 1-6 can provide a broader service of state interest than just by PBS alone.

Television Ancilliary Channels/Signals

1. Captioning on television programming for the deaf. It would be too expensive for individual stations to undertake captioning.
2. Teletext of TTY information sent within the vertical blanking cycle would provide document dissemination on video display or hard copy throughout the state in real time.

ITFS--Network

1. Simultaneous, multi-channel(4) distribution of instructional materials in to all parts of the State. ITFS systems will incorporate microwave lines between regions.
2. Simultaneous distribution of information and training to State offices or centers throughout the State. (For additional advantages and disadvantages of ITFS, see ITFS Working Paper.)

Dictating the construction of any network for telemedia dissemination are the following factors or questions:

1. Who will need to send the information?
2. Who will be receivers?
3. At which locations will the senders and receivers be?
4. Are they permanent locations or will someone be mobile?
5. How many hours will the network be used?
6. Are there alternative methods to a "real-time" network?
7. Could existing networks, such as police networks, data networks, or public service satellite be used on a temporary or permanent basis?

Possible Costs

The cost of constructing and operating a state network for telemedia distribution can only be determined after an extensive engineering and needs study. In the absence of an existing

network in Virginia and the many variables of terrain, tower heights, location of receiving and sending sites, FCC approval, etc., it is almost impossible to predict an exact operational/ construction cost figure or of savings to the State. An example from other states may help place the costs of networking in Virginia in perspective:

Wisconsin has a comprehensive state network for radio and television. The replacement value today is $27,559,000 and the annual operating cost was extracted as $6.5 million annually. The Wisconsin system consists of the Educational Radio Network (8 FM and one AM) with all stations licensed to Educational Communications Board. The television network (ETN) consists of five network owned stations and two affiliated public television stations. The above network owned and operated stations must be considered within the $27.5 million replacement value.

Conclusions

The interviews and studies of both national and state systems indicate a variety of conflicting views and facts concerning the need and structure of a statewide dedicated network in the areas of radio and television. The following findings are key:

1. There exists strong disagreement as to the priority of television networking and the cost-effectiveness of such networking.

2. The State communicators and consultants are divided in their opinions as to the technology to be used in television networking.

3. A needs assessment of intra-state networking, both radio and television (including data/facsimile) sponsored by

VPTC was conducted prior to April, 1976, and its findings may not be valid today due to changing needs and technologies.

4. Temporary video networks have been used in the past as needs arose.

5. The five public television stations are involved in discussions concerning the establishment of a type of state-wide television interconnection, either permanent or temporary.

6. There exists some agreement for the need of a state-wide radio network for news and public affairs (due to the low cost of the radio medium). No definitive proposal is extant.

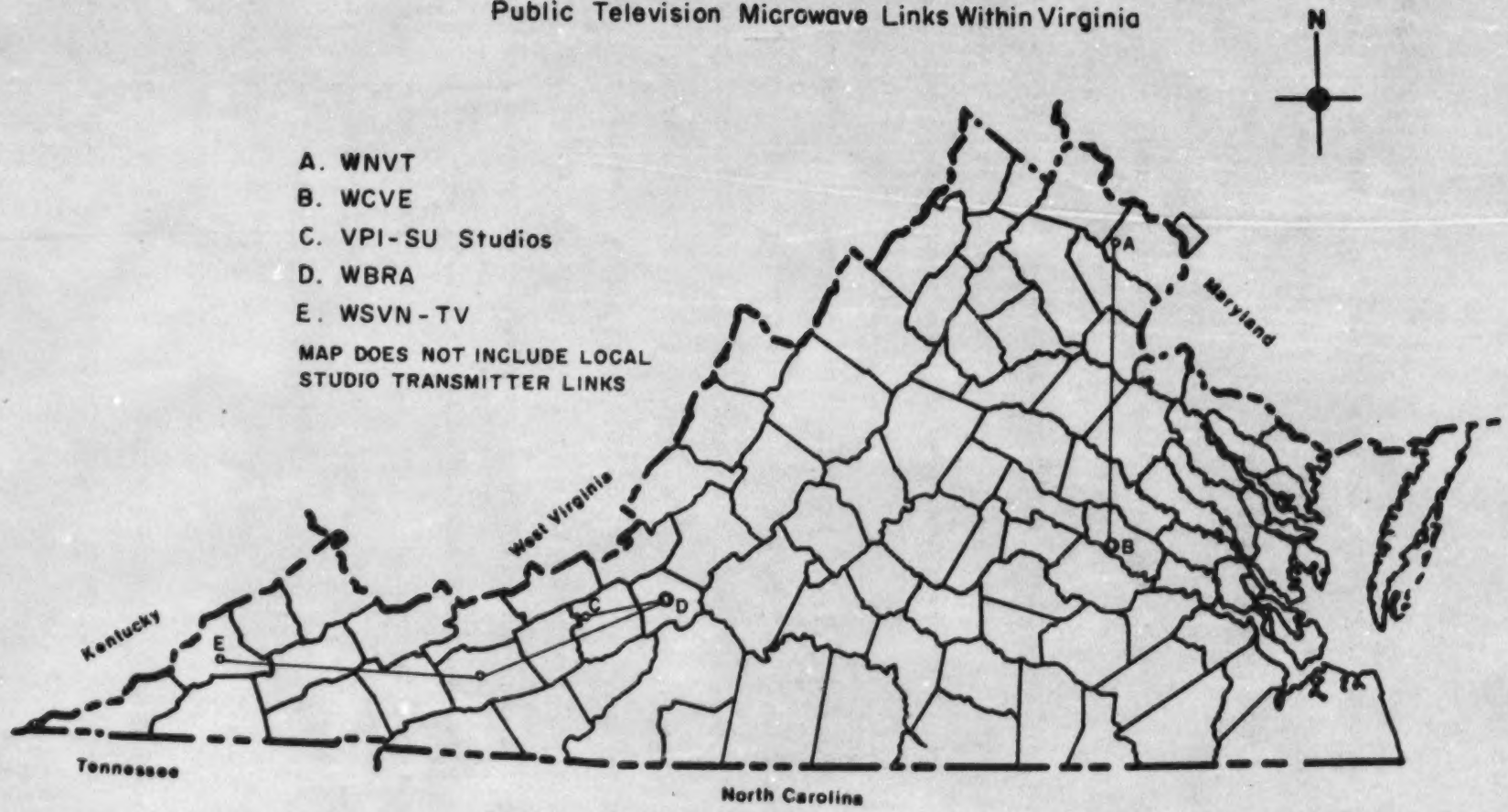
7. Emergency communications to the public can be handled via EBS (Emergency Broadcast System), a national network of commercial and non-commercial radio stations. The state has access to the network through the office of the Governor. It possibly should be handled through a central telecommunications coordinating body like VPTC.

8. There exists an available demonstration of an ITFS (Instructional Television Fixed Service) Network in the work and proposals of the Center for Excellence (CenTeX) in Williamsburg, Virginia.

9. The possibility of interconnecting local cable systems exists in the distant future.

10. There is a need for a telemedia network study which has a sufficient time frame and funding to explore needs and alternative systems for use by the Commonwealth whether for ITV or PTV distribution or both.

Public Television Microwave Links Within Virginia



APPENDIX A

13 Licensed

Non Commercial Radio Stations

(10 W Campus Stations Listed Sep.)

WVVT-FM 770W 150 ft. a.a.t

(703) 552-0640
Squires Center
Blacksburg 24061

VPI & State Univ. Licensee
Format: educ. & Diversified
NET: MBS
Mark Stein, Gen. Mgr.

WTJU--FM 750 W 105 ft/a.a.t.

Station #1, UVA
Charlottesville 22904
(804) 924-3418

Format: Progressive, Classical, some Jazz
NET: NONE

Karen Sacks, Pres.
Teresa Lazazzera--Mgr.

WMRA-FM 19.5 KW ant. 730 ft.

Madison College
Harrisonburg 22801
(703) 433-6221

NET: NPR

Dr. Ronald Carrier, Pres.
Station Mgr.--Don Lanham

WLUR-FM 175 W ant. 175 ft.

Lexington 24450
Washington and Lee Univ. (Private)
(703) 463-9111

Format: diversified

Robert J. deMaria, Gen. Mgr.
Robert E.R. Huntley, Pres.

WHRO-FM 26.5 W ant. 320 ft.

5200 Hampton Blvd.
Norfolk 23508

Lic: Educational Telecommunications Inc.
Format: Classical/community affairs
NET: NPR, APR

John R. Morrison, Gen. Mgr.

WNHS--FM 300 W ant. 115 ft.

2900 Turnpike Rd.
Portsmouth 23707
(804) 393-8664

Lic: School Board City of Portsmouth
Format: Educ., Top-40
A.T. Edwards, Gen. Mgr.

WBBL--AM Share-time with WLEE

1627 Monument Ave.
Richmond 23220
(804) 359-2463

Lic: Grace Covenant Presbyterian Church

WRFK--FM 50KW ant. 235 ft.

3401 Brook Rd.
(804) 264-2953

Lic: Union Theological Seminary
Mgr.--Charles Swan, Mgr.
Operations--Jerry Glass

Format: Classical, Religious
NET: NPR

WVWR--FM 100KW 1970 ft.

Box 4195
VA Wstern Comm. College
Roanoke 24015
(703) 343-4970

Lic--State Board for Community Colleges
Format: Educ. Informational, cultural
NET: NPR
Dr. Harold H. Hopper, Pres.

WCWM--FM 1.6 KW 125 ft. ant.

College of W & M
Williamsburg 23185
(804) 229-4068
Lic: College of William & Mary
Format: Progressive Spec. Programs 7 hrs. jazz
3 hrs. C & W

NET: MBS

Don Wilson, Gen. Mgr.
Bill Rives, Bus. Mgr.

WYCS--FM 21 KW ant. 155 ft.

Box 452
Yorktown 23490
(804) 898-5957

Lic: York County School Bd.
Format: Educational
Spec. Prog.--Vis. Handicapped 1 hr/wk
Donald Breno, Dir. Supervisor
William M. Swartz, Gen. Mgr.-Chief Eng.

New CP

WNSB-FM 1 KW ant. 117 ft.

Norfolk State College Not on Air

Upgraded from 10 W

WFOS-FM 1.5 KW 145 ft.

1617 Cedar Rd.
Chesapeake 23320
(804) 547-6216

Lic: Chesapeake Public Schools
Format: variety, educ,

John Rawls, Supervisor
Jack Garrison, Instructor

5 Licensed

10 W--Campus Stations

WWHS--FM 10W ANt. 140 ft.

Hampden-Sydney

Lic. Pres & Bd. of Trustees of Hampden-Sydney

WHOV--FM 10W

Lic: Hampton Institute
William Kearney, President (804) 727-5407

WEMC--FM 10W Ant. 99.5 ft.

Lic: Eastern Mennonite College
Mary Stockhouse, Gen. Mgr.

WDCE--FM 10W

R. H. Walker--Dir. of Public Info.
Lic:University of Richmond
Format: music-variety

WRRC--FM 10W 89.9 mhz (C.P.)

Radford College
William Yerich, Dir.

Target date unknown

APPENDIX B
(CONT)

Data National TV*

TV networks--6 national networks

ABC	PTL
CBS	CBN
NBC	PBS

3 specialized networks

Hughes TV Network--Sports

CD Chesley Network--Sports

TVS - Corinthian Broadcasting - Sports Corp.

ITV-Public TV networks

Western Eductional Network WEN

Southern Educational Communications Association SECA

Eastern Educational Network EEN

Central Educational Network CEN

Midwest Educational Television, Inc. MET

Ohio Educational Television Network Commission

Pennsylvania Public Television Network

*As listed 1979 Yearbook

DATA NATIONAL RADIO*

11 National Networks--Commercial

1 Educational--NPR

96 Regional Networks

3 Public Regional Networks

*As listed 1979 Yearbook

APPENDIX D

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CABLE SYSTEM POTENTIALS

The cable company is a local one, franchised or contracted to a community, city, or county. The evolution of CATV (Community antenna television) from the hills of Pennsylvania to today's broadband distribution systems has been a slow one, but has created a new equipment market with related engineering and design improvements: implemented local origination, public access and information display; developed satellite interconnection: permits selective programming; and also starts a whole new category of interactive services.

To understand cable television, one must understand the meaning of "broadband". This term indicates the useful portion of the frequency spectrum capable of being transmitted by one wire, and soon, one optical fiber. The primary breakthrough in cable technology was the use of coaxial cable which has a bandwidth of several hundred million cycles per second. Cycles per second can be equated to traffic handling capacity of cable, as width in feet can be applied to highways. The wider the roadway the more traffic can travel in either direction per a unit of time. -

The coaxial cable confines its energy within the outer shield and is minimally subject to interference from other electronic services. The same frequency assignments can be used in parallel cables, as is often required, especially when updating older systems. One must think of a cable system as a multi-lane highway, with each lane being capable of carrying a variety of traffic, independent of every other lane.

The CATV "head-end" is the point of insertion of programmed signals into the system. The head-end is often interconnected with "subhead-ends" called hubs, with a trunk cable or a microwave service called CARS (Cable Relay Service) as authorized by the FCC for up to 40 TV channels for this local distribution service.

From the "head-end" and/or hubs extend the main cables or trunks which divide or are tapped by "feeder cables" that travel the secondary streets of the city or county. The "feeder cables" are further tapped by "drop cables" that are attached to the subscriber's home, office, building, etc. This electronic tree network with today's technology installed could transmit two-way traffic along the same wires at the same time.

Very recently what is called the "CUBE" system was installed in Columbus, Ohio, and it demonstrated the use of "smart" taps which recognize an individual subscriber. The address code which is delivered on a cable control channel from a computer at the head-end can "connect" or "disconnect" a subscriber. In a more sophisticated version, this addressable tap can enable or restrict one or more specific channels at that subscriber outlet for specialized programming at selected times. (TTS 1979)

Uses of Cable Systems

The marriage of the computer and cable technologies allow for a multitude of home, government, and business services via cable. Special terminal devices in the home can "descramble" channels having restricted audio and/or visual information and permit a viable means for billing pay television programs. Hard copy, alpha numeric or facsimile, printers do not require TV sets at all.

"Frame grabbers" can select, store and transform single TV frames for display or readout on a TV or CRT screen. Interactive terminals, which permit the subscriber to talk back, make requests, transmit sensor information or seek emergency assistance, make use of the cables potential "upstream" (two-way) capacity.(TTS 1979)

The description of cable's potential could be endless. Several isolated systems which approach its partial potential do exist on the national level, but most systems at the present do not have the capacity to handle more than off-the-air broadcase signals and a few specialized subscriber services.

a) pay television movies - sports 35%

b) weather channels 69%

c) community bulletin boards 46%

d) local origination 19%

e) access channels 43%

(Cable Services Report - 79)

The average system has a 17-channel capacity of which 12 are activated and available for use. The average system doing local origination passes 15,095 homes and serves 8,058 subscribers in three communities. (Cable Service Report - 79)

About 33% of cable systems carry regular educational programming, other than local ETV (PBS) station carriage, and 45% of those stations have channels interconnected both to and from the schools.

Cable TV systems with two-way interactive capacity are experimenting with interactive education such as the Spartanburg Interactive experiments in Home Education and The Rockford, Illinios, project using interactive cable to delivery training to city fire fighters. Both projects showed minor learning increases using the electronic interactive system, but according to local users, the systems are worthy of continuation. "Currently, teachers at 14 Rockford schools are participating in interactive, inservice training as are nurses in three Rockford Hospitals." (EDS 1979)

Cable TV systems with two-way interactive capacity are also experimenting with methods of increasing citizen involvement in local government. The innovative CUBE two-way system in Columbus, Ohio, conducted a cablecast town meeting for suburban upper Arlinton in which about 2500 families participated - three times the usual town meeting attendance.

Another example: "In Reading, Pennsylvania, Berks Community Television developed a regularly scheduled, split-screen video program originated simultaneously from TV studios in senior citizens centers, the local high school, and city hall." (Cable Services Report 79)

The above listed examples are dramatic, as would the description of several other cable projects, but these are isolated successes often possible only through federal or other grant funding. The exception to this is the CUBE system where Warner Cable expects to demonstrate economic feasibility of two-way interconnection in an urban setting.

The future of cable is growth; within five years the cable industry could go from a 1.5 billion dollar a year business to a 10 billion dollar a year operation.

According to Michael H. Dann, TV conslultant, network TV and cable will co-exist, but cable will become more a program distributor. This will start in the urban setting, unlike the rural setting where CATV systems originally started. There won't be just the old television set. That will go out like the Brunswick radio or the spinning wheel. There will be, of course, a great variety of programs available - such as more offerings for children, 24-hour-a-day news and weather and serious drama.

But these systems will be much more than that. Customers will be able to order services, such as banking from their homes. They will be able to punch a button and see what the supermarket has for sale. Lots of people will work at home on TV screens linked to central offices in their city or a distant city. They will be able to take college courses at home and not go to the classroom except for the exams. (U.S. News & World Report, Sept. 3, 1979)

In the area of service or programming, most CATV operators distribute "off-air" commercial and non-commercial programs to subscriber homes in the community. When a CATV company originates its own programming, it provides services to the cable subscribers they could not possibly receive on an open channel, such as:

a) better reception of distant stations

b) 24-hour weather information

c) movies (pay TV)

d) Madison Square Garden - sports

e) news - automated

f) imported stations via microwave or satellite

Besides the above listed services, other specialized services can be provided to education, governmental agencies, and public information from government.

Cable channels which cannot be recieved in the home make private teleconferencing feasible so that privacy could be protected. The subcarriers cannot be received in the home, but if further secrecy is required, scrambling equipment can be employed.

The main problem with cable today is the same problem with early telephone installations; if one lives too far from the trunk lines, he may not be able to obtain a CATV "dropline" due to cable cost escalation costs of up to $8,000 per mile. This cost is typical in rural areas, and, sometimes, in dense urban areas underground cable may run as high as $80,000 per mile. Therefore, the cable operator is not interested in going after the single outlying customer. The 30 percent home penetration as predicted by 1985 (Frost and Sullivan) will probably begin to level off and in the future about 70% penetration could be best to hope for, as contrasted with the "open air" broadcasters at 97%.

At the national level, subscriber penetration varies from approximately 8% in heavy broadcast service areas to about 71.9 in Santa Barbara, California, a very active cable community. The average penetration seems to stabilize around 55%. (EDS) As more services are offered by the cable companies, the penetration of TV in homes can elevate above the quoted figure.

CATV Regulation

At the national level, 381 cable systems which carry regular educational programming offer a total of 475 channels for this purpose, with 80% of the systems providing such channel space free. Such access requirements were mandatory according to the 1972 FCC cable rules, but have since been overturned (FCC vs Midwest Video) by the Supreme Court. It is in the interest of the community during the franchising process to insure that such channel space is provided for educational as well as governmental purposes.

The FCC rules no longer require the cable operators to provide free channel space and possibly sometimes production equipment to schools or government agencies, but most large companies do indicate an interest in providing such channel space and services due to the public relations factor in receiving additional subscribers and filling the available channels with a multitude of services.

State buildings, schools, municipal buildings, etc., can be easily interconnected when cable lines pass the buildings. Interconnections of this type can be contracted or outlined during the

franchising process. The process is a local one and each cable company in each individual locality differs considerably in technical capacity and services offered.

On a national level the cable industry has been a highly regulated industry with requirements as to signal carriage, protection of local broadcast interests and system requirements. The present trend in Congress and by the FCC has been one of deregulation, but there are limits as to how far such deregulation can and will go. The House of Representatives Bill (H.R. 3333) known as the "rewrite" bill apparently has been withdrawn from consideration for this year. The "rewrite" bill could have prohibited any governmental authority to regulate the cable industry. The prohibition would have covered all aspects of cable regulation including technical standards, rates, broadcast signal carriage, access channels and services. Two Senate bills are still pending and it is impossible to predict which direction the Congress will take. One was introduced by Senator Ernest Hollings (D-SC), the chairman of the Communications Subcommittee (S-611), the other by Senator Barry Goldwater (R-AZ) (S-622).

Both bills divide the regulatory authorities between federal and nonfederal governmental units. In addition, both bills permit telephone companies, under special guidelines, to provide CATV type services. The Goldwater bill (S-622), however, is the only bill that devotes an entire section to cable television and sets up three categories of regulation:

a) items under FCC regulation

b) items under state and local jurisdiction

c) items which may not be regulated by any government

The FCC would leave jurisdiction of technical standards, radio-TV signal carriage, and cross-ownership between cable and telephone companies. The local governments would regulate such issues as use of streets, franchise fees, and other local issues. The areas originated, and pay TV programming and pay TV rates, and access rates could not be regulated by any governmental body.

The courts and the FCC have also taken a deregulatory trend. The FCC has taken steps to deregulate the areas of signal carriage and the importation of distant stations, and in a recent decision, the Supreme Court overturned cable access rules and New York state's cable commission's regulatory stance of pay TV rates.

The major undecided issues on the national level can be listed as follows:

a) regulation or deregulation of the cable industry and by whom - FCC, state, local?

b) the industry is attempting to determine whether "interactive" and or "smart" terminals will be used and therefore profitable, especially for the smaller systems.

c) there is some national concern as to "privacy" of the "interactive" cable systems, especially ones capable of polling, billing, and banking. These systems could monitor and record various transactions and family-viewing habits of the cable subscribers.

d) Local access requirements appear to be still an option even though no longer an FCC requirement. The local governments can freely negotiate with the cable operators for services and

access rights. The concern here is that "access provided solely on the basis of the former FCC rules is now voluntary and could be terminated. While it is doubtful that there will be immediate, widespread abandonment of existing services by the operators, there is most certainly cause for concern." (CTIC - May, 1979)

e) America's top 10 CATV operators control more than 1/3 of the cable industry, therefore, a decision by a relatively few operators could affect the industry and the services offered. Such developments and practices may counter the anti-trust laws of the U.S. as they have been applied toward communications and broadcast services in the past. The FCC and Congress have always attempted to "localize" or "decentralize" the industry. Total deregulation of this issue is unlikely.

f) Finally, there is speculation as to the effects of new technologies upon the cable services: digital video, video cassettes, video disc, home-type micro-computers. How will higher availability and lower cost of these technologies affect the subscriber rate and demographics?

Virginia Cable Status

The cable systems in Virginia seem to dominate two geographic areas: the mountains, where cable is needed for better reception of television signals, and the urban areas, where cable can demonstrate better reception and multiple other services that can be utilized by an urban population.

Virginia has 87 cable systems serving 166 communities with 210,000 subscribers. The above numbers will not remain static

but can be expected to grow rapidly, especially in the number of subscribers. This growth will probably take place in the urban areas;

a) the Tidewater area is expanding

b) Henrico County and Richmond are just starting to develop

c) Northern Virginia where the new Artec System in Arlington and Alexandria was just granted a franchise. These new systems will be capable of two-way communication and services for the citizens of Virginia, such as:

a) electornic banking from home

b) sales and shop information

c) pay TV

d) the electronic office

e) security signaling: fire/theft

f) home convenience services

g) polling.

The home TV set can become an electronic communications center linked via cable-to-satellite, or cable-to-microwave, and thereby linked to a central "head-end" in, say, Richmond. State agencies and offices could use the system for transfer of data, graphic information, voice information, and possibly polling the population as can presently be done in Columbus, Ohio. (The CUBE System)

This is possible through the marriage of computer, micro-computer, and cable technologies. To achieve this takes modern two-way capable cable systems - the type that will be found more readily in urban areas.

In Virginia this will require considerable expansion either by private industry or state assistance to support state needs in cable communication. Most systems in Virginia (80%) have only 12 channel capacity without any "two-way" provision built in. Some systems, such as Staunton, Virginia, are expanding or upgrading their plant to dual-line 12 channel systems giving a total of 24 channels. The same systems are also installing satellite down-link stations for the reception/distribution of pay TV, "super stations", and news and weather services.

The average plant size in Virginia is estimated to be 60-80 miles in length with about 6,000 subscribers. The largest is Hampton Roads with 366 miles and the smallest 2.5 miles on Tangier Island.

It is unlikely that the very small systems in the small communities would find it profitable to convert in the near future to 30-40 channel broadband capacity with two-way services provided. The development of technology and the linkage of smaller systems via microwave or satellites into larger grids. Such capacity and service demands may develop to make a sophisticated system feasible, but that could only take place in the distant future (say, 10+ years).

Once such commercial services are in place within a large system, the system can provide governmental, business, health, and social services via cable. It was found that about 60% of the Virginia systems have 1 to 3 unused channels (Cablecasting Source Book - 1979) with some systems having 10 or more unused channels.

Local origination is lacking in Virginia with only two to four systems doing any live programming (e.g., Winchester, Danville). Other services include weather, FM, radio channels, announcements, automated origination, etc. Ten commercial cable companies are linked via satellite to distributors of services and provide those to their subscribers.

The cable-satellite link can provide the service on a lease basis for state government use channels. As more and more cable operators install satellite down-links, the feasibility exists for linking offices, homes, or anyone on the cable system for delivery of varied information - video, audio, or both. Data, as a separate channel or an ancillary signal to the TV signal, can also be considered. (See Appendix A)

The cable potentials for Virginia are there, but development of the ideal will be very slow in coming into realization due to federal deregulatory stance, leaving it to the local governments to negotiate the systems. This posture will create a variety of system franchises as it has in the past and interconnection or interfacing systems into a network may be difficult. Commonwealth agencies are not well educated in cable technologies and issues.

These issues are changing rapidly at the federal level with Congress, the Supreme Court, and the FCC rapidly deregulating cable, especially in the area of programming. The areas of technical quality at the receiving site, pole attachment, fee regulations, and the licensing of cable operators may remain the FCC's domain; but the recent national mood of deregulation and investors becoming aware of cable potentials point to an increase

in cable development, especially in urban areas where local broadcast television lacks vitality. The urban area offers the high density population necessary for reasonable to high profit return for the cable operator. Much of the new development, especially in smaller communities, will not include two-way capability since this is no longer an FCC requirement. One-way cable expansion can be anticipated in most non-urban areas.

State involvement in Virginia has been regulated by the Master State Plan for Public Telecommunications. (Part I, Chapter III) "Policies relating to certain minimum standards for CATV systems." The chapter requires a "Commonwealth access channel" on call by the VPTC, and the development of "Committees of Educational Interests" to advise the locality and the cable operators as to programming specifics and needs. The chapter as written is no longer valid due to recent Supreme Court rulings and FCC deregulation of the cable industry. The state role and of the VPTC has been one of advisory nature to the franchising locality or government unit.

The advisory role, as per request by the municipality, is supported by the VPTC, as well as the cable industry in Virginia. It is the feeling of many communicators and out-of-state consultants that the state should take a stronger leadership role relative to cable. The Virginia Cable Association (VCA) indicated that the Commonwealth should encourage an independent telecommunications agency and such agency should educate other state agencies and localities in cable technology and its possibilities. The New York State "Cable Franchising Workbook"

is a good example, even though some of its rate regulatory stance has been struck down by the Supreme Court.

Stronger state leadership could result in a more systematic approach to cable development and provide in the future an excellent communications grid for the state. The exact configuration of the grid depends upon future regulatory and technological changes at all levels.

Since cable interconnection has been a local matter, it is difficult to determine the exact use of cable by educational institutions, but uses have been made in varied instances:

a) aid in reception of public tv stations within schools and the reception of instructional programming.

b) the distribution of instructional materials from a central school studio - AV center to other schools within the local system.

c) creation of in-school television productions and distribution of same through the cable systems to the general public and other schools.

A recent survey by VCA did not provide a high enough return to codify the numerical data for the educational usage of cable systems.

Some school divisions such as Lynchburg Public Schools have agreements with cable companies and use one or more of the channels for instructional purposes. Lynchburg rebroadcasts WBRA and WVPT ITV programming at a later time, thus providing an alternative schedule. In addition, Lynchburg Public Schools can distribute its own informational and instructional programs to students, staff and the general public.

Presently, the Virginia public tv stations are entering into negotiations with local cable companies to feed additional "non-open-air" programming from their studios (WBRA, WHOR). The multiple-channel PBS service will allow programming that is not designed for large audiences to be fed via cable, and therefore, give the cable subscriber and schools more choices as to the type of instructional programming needed. These same channels could also be used for governmental activities.

In higher education very little activity has taken place except on a highly individual basis. Media representatives from four colleges in South Tidewater have formed a consortium to pursue the development of a cable television educational access channel. Cox Cable of Atlanta has the franchise for all three cities in South Tidewater and, upon completion of the system, will pass more than 120,000 homes. Cooperation and sharing of resources will benefit all the colleges concerned. (VTR News)

The consortium idea is developing also in several other areas of media programming and administration, but at the present it is only in the beginning stages.

It appears as more colleges, school systems, and state agencies feel the inflationary cycle, the idea of consortia will develop in the state. Shared use of facilities and awareness of cable technologies should grow from the scattered beginnings. The cable operators have expressed their disappointment in the lack of channel use by higher education when such channels were being offered at no cost. The no cost stance is not an

indefinite one. As more cable services develop for the consumer from which the operator may profit, less use of their service for "free" government uses can be predicted on a free or low-cost basis in the future.

The development will be a slow one due to faculty and administrator resistance to such development. There is not an acceptable system for faculty remuneration and workload distribution for fully mediated courses. Until this problem is solved, the progress of cable use, or even PTV or public radio, in higher education will be very slow.

Cost

The cost of obtaining an access channel for education or governmental use is a local option and must be negotiated with individual cable operators. The operators have allowed in the franchising processes free educational and governmental channels as formerly required by FCC.

The cost of authorizing the operation of a channel costs the operator $200,000 per year in a large system. In Virginia, as well as nationwide, the cable operators have been willing to donate channel space for educational or social services or lease the channel on cut-rate basis. One dollar a year negotiated contracts for full channel use are not uncommon.

SUMMARY

The Virginia cable systems are locally franchised or licensed to provide an antenna service in areas of poor TV reception. Many systems provide other services as much as their channel capacity will allow on a fee basis, many times free for educational and governmental use.

The newer systems developing in urban areas will depend upon non-broadcast services for their attractiveness to the community and subscribers such as pay-tv with uncut movies, special sports events, special service channels for safety, education, and social services.

The cable climate is in the process of change due to federal deregulation and an interest by investors to develop cable systems in urban areas. This interest is aroused by the deregulatory stance of the federal government, as well as the increased availability of varied services that can be offered via cable.

The following conclusions may be drawn hesitatingly due to the rapidly changing regulatory and financial climate in the cable industry:

1) many state agencies are not fully aware of the potential of cable carriage and potentials.

2) there is not available at the state level a central data base about cable usage in Virginia.

3) Higher education has not been ready and/or willing to embrace the cable technology for distribution of educational materials, except in a few isolated cases. This may be changing.

4) VPTC has taken a "advisory-by-request" stance to cable regulation as an aid to the franchising process.

5) Consultants and state communicators feel that a stronger educative or possibly regulatory stance should be taken by involved state agencies.

6) There is agreement that there should be a state developmental plan toward the growth of cable, not necessarily a regulatory one towards the industry or communities.

7) The Virginia school system makes use of cable technology whenever applicable to the reception of ITV signals from the PTV stations and sometimes other instructional and public cablecasting takes place from the school into the cable system.

8) There is no statewide plan except for advisory stance (VPTC) for the development of cable within the Commonwealth.

APPENDIX A

TELECOMMUNICATIONS TECHNOLOGY

CABLE CARRIAGE POTENTIAL

VIDEO PROGRAMMING

- BROADCAST TV -VHF & UHF
  - LOCAL & REGIONAL - DIRECT AIR RECEPTION
  - DISTANT - MICROWAVE
- NON BROADCAST - LOCAL/DISTANT
  - PREMIUM - PAY CABLE
  - INSTITUTIONAL - EDUCATIONAL, RELIGIOUS, GOVERNMENTAL
  - COMMERCIAL - PRODUCT OR SERVICE PROMOTION
  - TELEMEETING - PRIVATE LINE OR DEDICATED VIDEO.

AUDIO PROGRAMMING

- BROADCAST RADIO - FM OR CONVERTED AM
- NON-BROADCAST RADIO - SHORT WAVE
- BACKGROUND MUSIC
- INFORMATIONAL - ANNOUNCEMENTS
  - INSTITUTIONAL, TRAINING
  - DEDICATED

GRAPHICS - TEXT & PICTORIALS

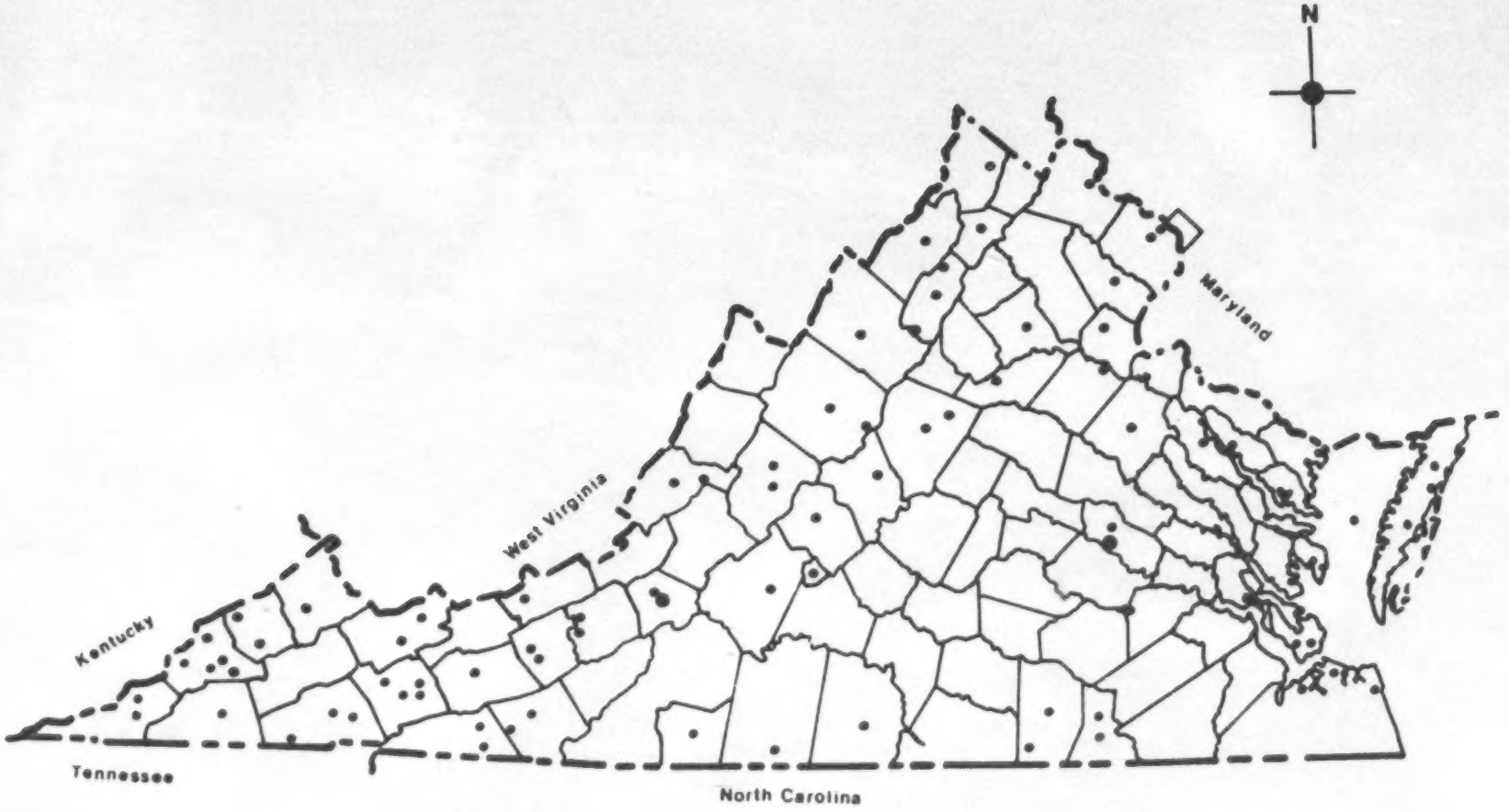
- SOFT COPY - TV OR CRT DISPLAY
  - TV CAMERA GENERATED
  - "FRAME GRABBER"
  - COMPUTER GENERATED
- HARD COPY - PAPER PRINTOUTS
  - ALPHA NUMERICS
  - FACSIMLE -LINE A/N SCRIPT

DATA - BIT RATES FROM 0 TO 60 MBS

- COMPUTER TO COMPUTER
- TELEMETRY - COMMANDS, SENSORS MONITORS

INTERACTIVE - TWO-WAY, SUBSCRIBER RESPONSE SYSTEMS

- SECURITY - UTILITY MONITORING
- OPINION POLLING
- INFORMATION REQUESTS
- ASSISTED EDUCATION - PERSONAL OR COMPUTER
- RESERVATIONS - TRAVEL, TICKETING, PROGRAMMING
- SHOPPING - PRODUCT SELECTION
- ELECTRONIC BANKING
- FASCIMILE TRANSMISSION



CABLE HEAD-END LOCATIONS

APPENDIX B